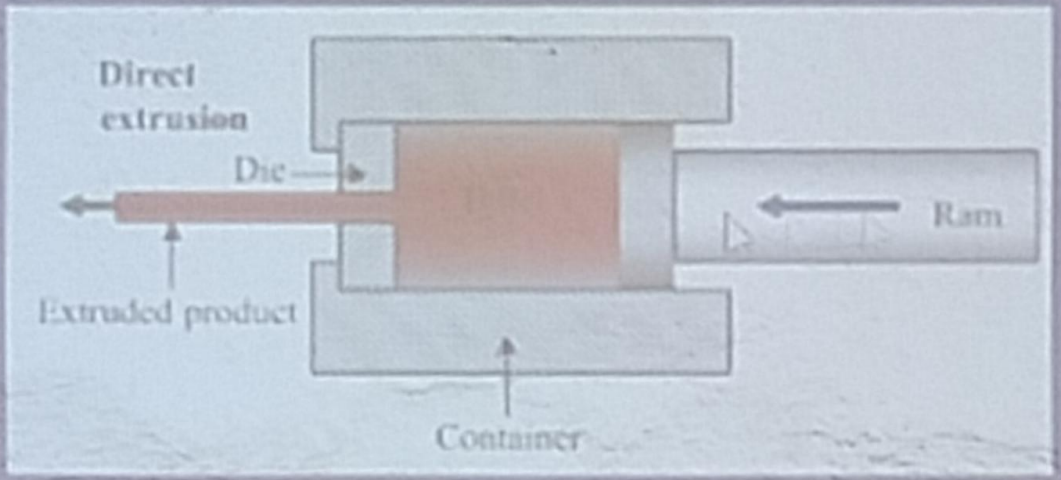
Forming Processes - Direct Extrusion -

The metal billet is placed to the container of the extrusion press. The die with an opening is mounted at the end of the container.

When the hydraulically driven ram presses the billet, the metal starts to flow through the opening forming the extruded product of the required cross section.

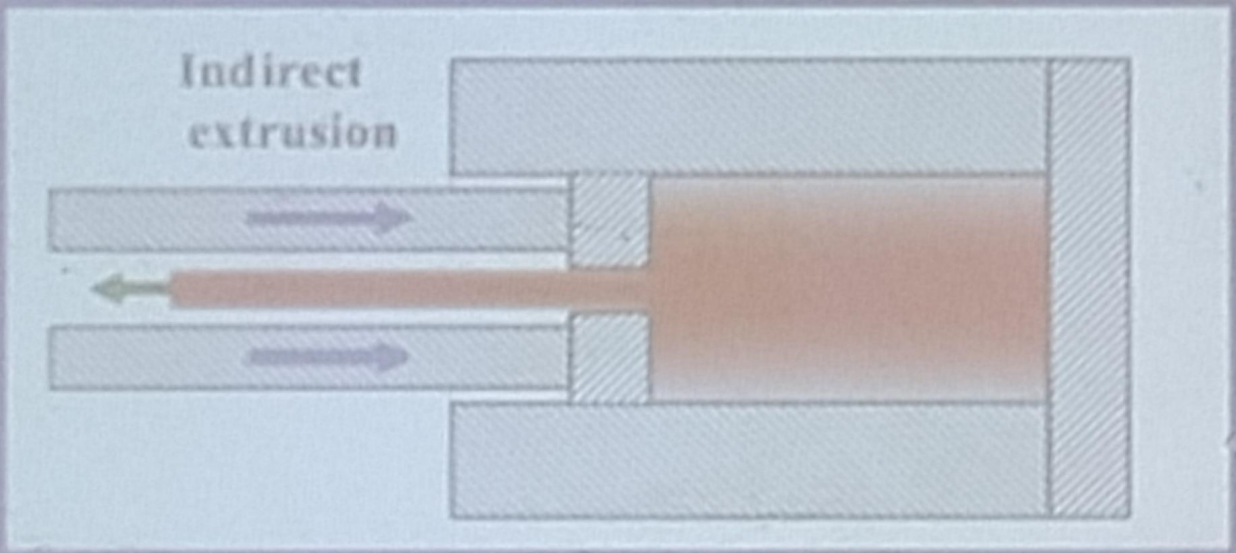
In the direct extrusion the extruded metal flows in the direction of the ram motion.



Forming Processes - Indirect Extrusion -

In the indirect extrusion the metal flows in the direction opposite to the ram motion.

Indirect extrusion requires a lower force than direct process as there is no friction between the billet and inside walls of the container.



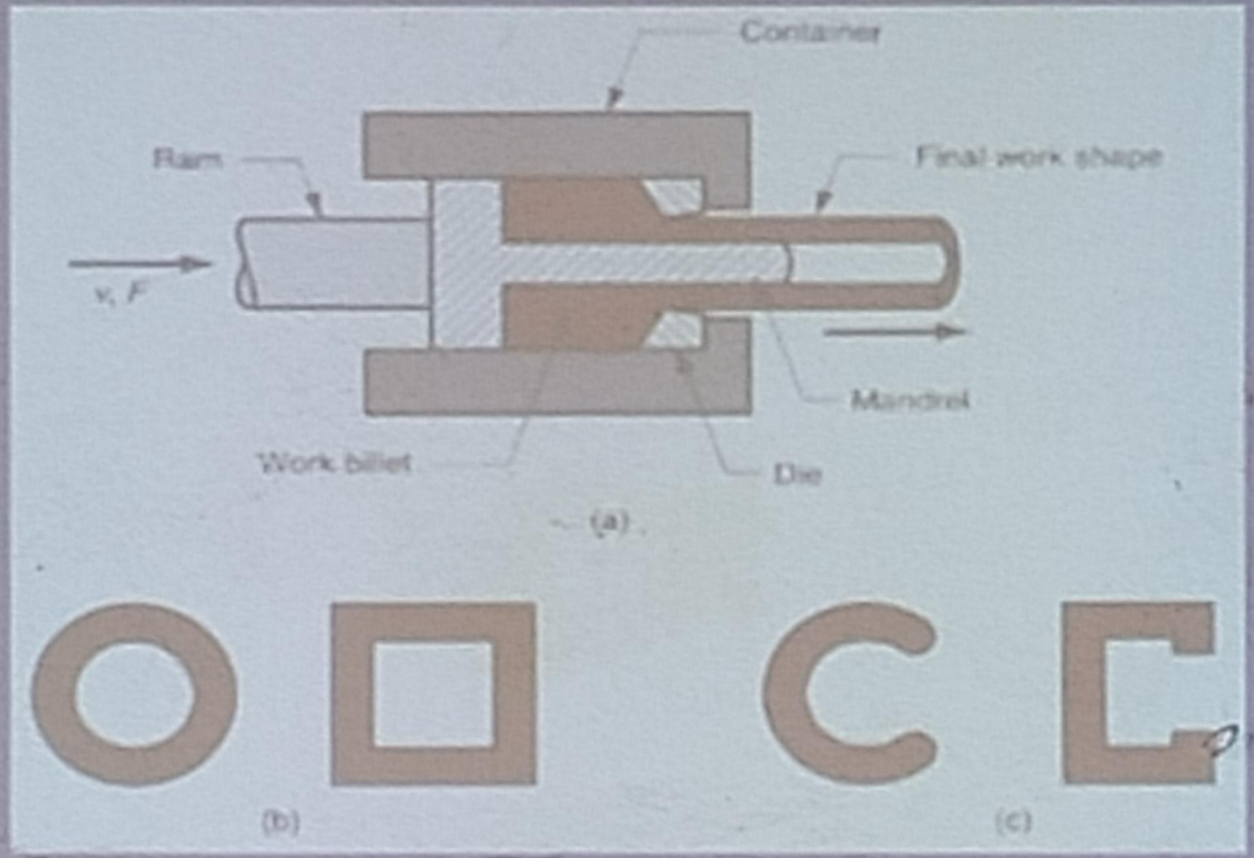
Forming Processes - Extrusion -

In the hot extrusion process the metal billet is preheated to the required temperature: (450°C - 500°C) for aluminum alloys and (700°C - 800°C) for Copper alloys.

The dies are manufactured from hard alloyed steels.

Extrusion is used for manufacturing round and hexagonal rods, tubes, various profiles (mainly aluminium) and other shapes. Typical examples of parts made by extrusion are the [illegible].

Hollow and Semi-Hollow Shapes



(a) Direct extrusion to produce a hollow or semi-hollow cross sections; (b) hollow (c) semi-hollow cross sections.

Extrusion Ratio

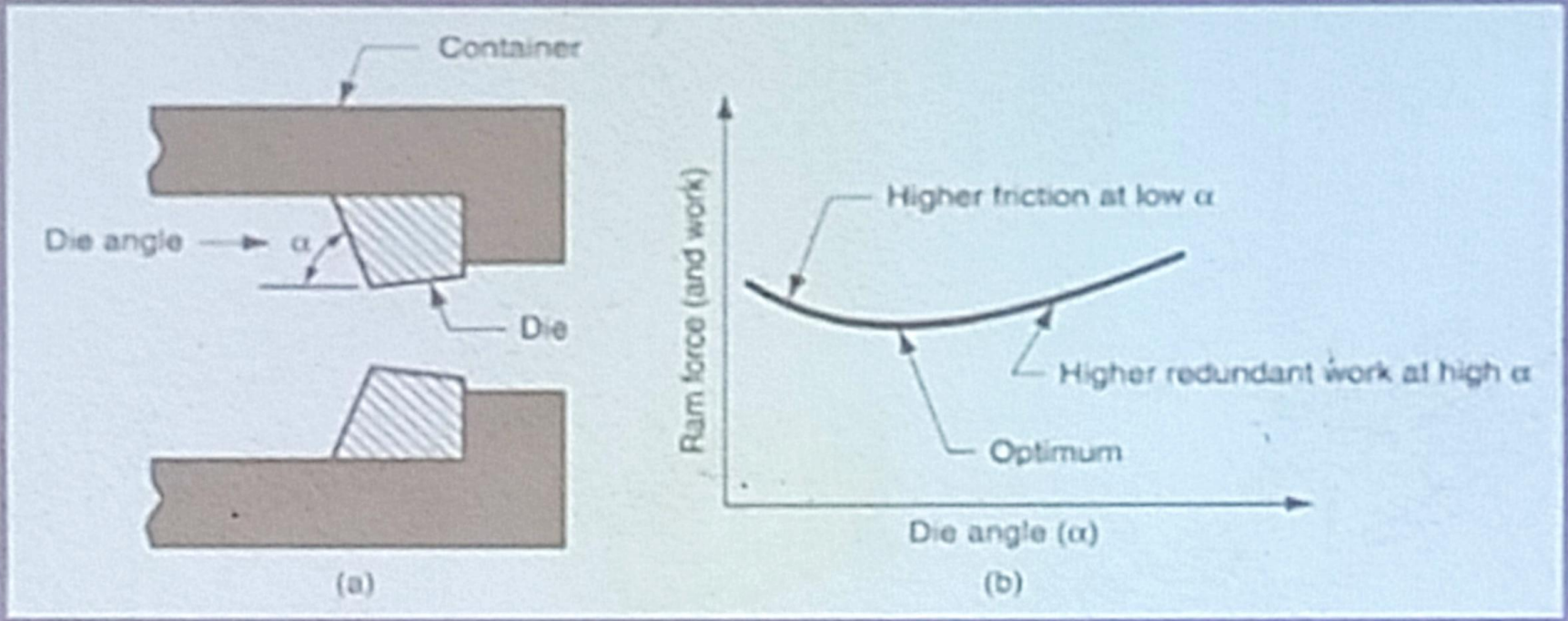
Also called the *reduction ratio*. it is defined as

$$r_x = \frac{A_o}{A_f}$$

- where,
- r_x = extrusion ratio;
- A_o = cross-sectional area of the starting billet;
- A_f = final cross-sectional area of the extruded section

- Applies to both direct and indirect extrusion

Extrusion Die Features



(a) Definition of die angle;

(b) Effect of die angle on ram force.